INFILTRATION CONTROL COVER TECHNOLOGY DEMONSTRATION AT MARINE CORPS BASE HAWAII, KANEOHE BAY

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Introduction. The Navy has over two hundred landfills that must be remediated. Since surface covers are the least expensive method to effectively manage the human and ecological risks associated with these landfills, these covers will most likely be the method of remediation chosen for many of these landfills.

To demonstrate the effectiveness of such cover systems, the Naval Facilities Engineering Service Center (NFESC) has teamed with the Los Alamos National Laboratory (LANL). The Environmental Science Group at LANL, with Colorado State University (CSU), has investigated the performance of a variety of landfill capping alternatives, with field demonstrations in New Mexico and Utah. During the summer of 1994 a demonstration cap was installed by NFESC and LANL at Marine Corps Base Hawaii (MCBH), Kaneohe. The goal of these studies is to develop a variety of field tested capping designs so that the risk manager has cost-effective design alternatives to match the need for hydrologic control at the site.

Background. Los Alamos capping technologies incorporate design features that control one or more of the processes governing the fate of precipitation failing on a site. The fate of meteoric water failing on the surface of a landfill is often referred to as the water balance of the site. It can be represented as an equation:

$$\Delta S/\Delta t = (P - Q - ET - L) / \Delta t$$

where:

$\Delta S/\Delta t$ = time rate of change in soil moisture
P = precipitation per unit area
Q = runoff per unit area
ET = evapotranspiration per unit area
L = percolation below root zone per unit area
t = unit of time used in solving the equation

Application of the concept of water balance in designing landfill caps takes advantage of the fact that there are strong interactions between the various components of the water balance. For example, a reduction or elimination of the runoff term, Q, increases infiltration of water into the soil, resulting in increased soil moisture storage followed by an increase in evapotranspiration, ET, and/or percolation, L. The coupled nature of the processes comprising the water balance can be used to design landfill caps that minimize or eliminate processes in the water balance that contribute to contaminant migration (i.e., percolation) while enhancing other terms (i.e., evapotranspiration) that do not.

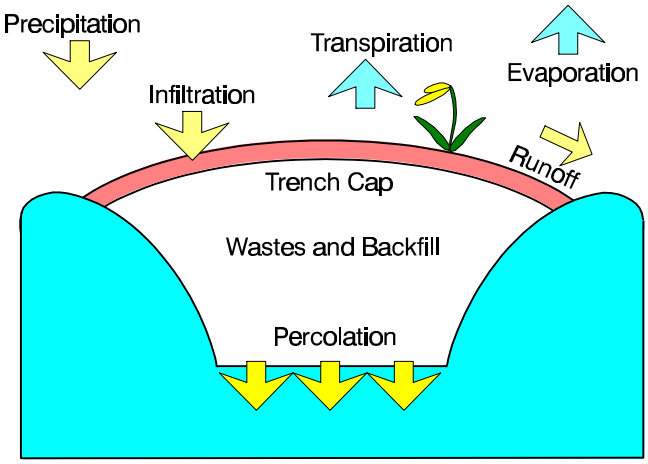

Diagram of the water balance equation.

Kaneohe Study. The study at MCBH Kaneohe Bay uses an innovative, but simple and inexpensive, concept to manipulate the fate of water falling on waste sites with high precipitation. The infiltration of water through the cap will be controlled by combining the very powerful evaporative forces of native vegetation to remove soil water with engineered structures

that limit infiltration of precipitation into the soil. This approach relies on diverting enough of the annual precipitation to controlled runoff so that any water that infiltrates into the soil can easily be removed by evapotranspiration. The study will field demonstrate two infiltration-control designs, one involving a 20% enhancement of runoff, the other a 40% enhancement; and a conventional soil cap (control) to serve as a basis of comparison. The equivalency of the three designs to the EPA RCRA design will be evaluated by comparing the field monitoring data with the predicted performance of the RCRA design using the HELP model.

All plots are equipped with instruments to monitor daily precipitation, percolation, runoff and sediment yield, and soil moisture in order to compute a water balance for each design. Evapotranspiration is estimated. Automated data acquisition systems are used for most of the measurement variables. Periodic measurements of species composition, biomass, canopy cover, ground cover, and leaf area index will also be taken of the vegetation cover on each plot.

Preliminary Results. After 1 1/2 years of monitoring at MCBH Kaneohe Bay, an evaluation of the preliminary results have supported the concept of infiltration control by increasing runoff and reducing percolation. It was found that about 75 to 98% of the runoff occurred during large rainfall events during a 2 to 4 month period. Also, the 20% runoff plot was just as effective as the 40% plot. In summary, the monitoring results support the concept of an evapotranspiration cap design alone or in conjunction with enhanced runoff.

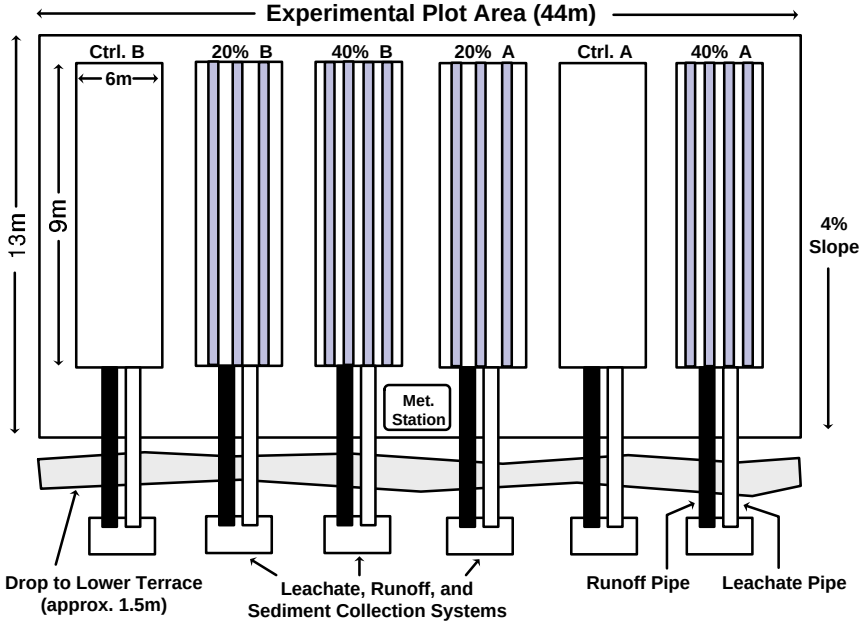

Diagram of the study area.

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